BEACH EROSION CONTROL STUDY
OF
DOLLIVER NECK
GLOUCESTER, MASSACHUSETTS

5 March 1965

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

BEACH EROSION CONTROL STUDY OF DOLLIVER NECK GLOUCESTER, MASSACHUSETTS

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U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASS. 02154

ADDRESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO. NEDED-R

5 March 1965

BEACH EROSION CONTROL STUDY OF DOLLIVER NECK, GLOUCESTER, MASSACHUSETTS

GENERAL

1. Authority. - This report was prepared by the Corps of Engineers, United States Army in accordance with request initiated by letter from the Commander, First Coast Guard District, dated 24 December 1963. The work was authorized by a "Request for Work", No. ecv 331-64 dated 20 March 1964, acknowledged and accepted by John Wm. Leslie, Chief, Engineering Division for the Division Engineer on 27 March 1964 in accordance with ER 1140-2-302, dated 24 January 1964.

2. Purpose. - The purpose is to perform necessary engineering studies to determine the cost and corrective action necessary in connection with an accretion and mooring problem at the U. S. Coast Guard Lifeboat Station, boathouse and launchway site located at Dolliver Neck, Gloucester Harbor, Gloucester, Massachusetts.

3. Prior Reports. - The latest published reports of navigation and beach erosion control studies in the general vicinity of the study area are as follows: Rockport, House Doc. 515, 87th Congress, 2d Session; Gloucester Harbor, House Doc. 341, 87th Congress, 2d Session; Sandy Bay, Cape Ann (Harbor of Refuge), House Doc. 3, 65th Congress, 1st Session; and Rockport Harbor, House Doc. 363, 56th Congress, 1st Session. These reports contain some general information which is pertinent to the beach erosion control study.

4. Location. - Dolliver Neck is located in Gloucester Harbor, at the southern extremity of Cape Ann about 25 miles northeast by water from Boston Harbor. The harbor is protected on the east by the southerly arm of Cape Ann, but is exposed to southerly storms. The mean range of tide is 8.7 feet and the spring range is 10.1 feet. The locality of Gloucester Harbor is shown on U.S. Coast and Geodetic Survey Charts 233, 243, 1207 and on maps accompanying this report.

5. Description. - Cape Ann, is a rocky headland separated from the mainland, to the west, at Gloucester, by the Annisquam River. The bedrock comprising this headland is igneous in origin, consisting mostly of granite. Rock is exposed at many places. Except at outcrops, this bedrock is covered by a very thin overburden of glacial till. The ragged shoreline of southeastern Cape Ann which includes the study area, Gloucester Harbor and Sandy Bay, is the result of the uneven composition of the igneous rocks and the consequent differential erosional development.

6. Statement of the Problem. - Accretion and shoaling has occurred at the boathouse and launchway site located at the U. S. Coast Guard Lifeboat Station at Dolliver Neck, Gloucester Harbor, Gloucester, Massachusetts. The shore adjacent to the boathouse has reportedly accreted over a period of years. During easterly storms, littoral drift piles on to the marine railway. Shoaling has occurred in the water area around the boathouse and the marine railway. Wave attack adversely affects Coast Guard boats moored near and on the launchway particularly during east and northeast storms. The Coast Guard moors these boats, one on the launchway and one each flanking each side of the outer end of the launchway. During more serious storms the boats have to be moved and moored elsewhere in Gloucester Harbor.

FACTORS PERTINENT TO THE PROBLEM

7. Littoral Materials. - The materials being deposited at the launchway were formed by erosion, movement, sorting and deposition of former rocks and glacial till.

8. Littoral Forces. -

a. Waves. - The study area is directly exposed to wave action from the south to the southeast across Massachusetts Bay. It is protected on the east by the southerly arm of Cape Ann. No wave measurements are available for the immediate area. Hindcast wave data based on synoptic weather charts for locations along the North Atlantic coast have been prepared and published by the Beach Erosion Board. A wave rose from this data for a location off Nauset Beach, Cape Cod, Massachusetts is shown on Plate No. 1. It indicates that waves occur with greatest frequency from the northeast and east directions. Waves from the southeast quadrant which can approach the study area more directly occur with considerably lesser frequency. The shore is sheltered by the mainland from the west. Waves can approach the shore from the northeast over a limited fetch.

b. Currents. - Tidal currents are negligible, setting in and out of the harbor with comparatively small velocities. Observations of disposition of littoral material here and pocket beaches to the north indicate an appreciable northerly littoral drift.

c. Winds. - United States Weather Bureau wind records for Boston, Massachusetts, the nearest weather station, located approximately 30 miles southeast of the study area show that prevailing winds approach the study area from westerly directions. A wind diagram based on hourly observations of wind speeds and directions for the ten year period from October 1949 through September 1959, inclusive, is shown on Plate No. 1. It indicates a high preponderance of westerly winds with the greatest duration from the southwest direction and little difference in duration between the northeast and southeast quadrants. Winds from the southeast quadrant, although relatively infrequent, approach over a long fetch and can therefore generate large waves which directly approach the shoreline of the study area.

d. Storms. - Records from the United States Weather Bureau at Boston, Massachusetts for the 75-year period 1870-1945, inclusive, show a high preponderance of northeast storms. These storms represent major disturbances of considerable duration, often accompanied by rain or snow, and high tides. The wind rose on Plate No. 1 shows storm winds from the northeast occur most frequently. The study area is partially sheltered in this direction. Waves from the northeast can approach the study area over a fetch of two nautical miles. The shore is directly exposed to storms from the southeast from which direction storm winds are least frequent and of short duration.

e. Tides. - Tides are semi-diurnal. The mean tidal range is 8.7 feet at Gloucester Harbor. Corresponding spring range is 10.1 feet. The estimated highest tide experienced at Gloucester Harbor is 13.0 feet above mean low water. Based on averages from a 30-year record, tides at Boston exceed the plane of mean high water by 2 feet or more 24.5 times a year, by 3.1 feet or more about once a year and by 3.5 feet or more 0.2 times a year. Comparison of high tides which have occurred at Boston and Gloucester over a three-month period indicate that tides at Gloucester vary from the mean range about the same as at Boston.

9. Shore History. - There reportedly has been erosion of 55 feet since 1911 along about 300 feet of the low bluff at the private shore east of and adjacent to the Coast Guard boathouse property. This erosion may be the principal source of supply of shoaling material and accretion.

10. Analysis of the Problem. - The problem appears to result from (a) swells entering the harbor and being refracted around Dolliver Neck and approaching the shore in the launchway vicinity, (b) wave reflections from the opposite shore, and (c) easterly winds. Accretion, shoaling, and wave attack reportedly occur only during easterly winds. East winds cause the most severe condition. Southeast winds also cause severe conditions if the southeasters are of prolonged duration. These local winds apparently reinforce the swells and create the problem.

11. Design Factors. - Proposed protective measures are designed to provide complete protection against wave attack during ordinary weather conditions of comparatively frequent occurrence and a large measure of protection against exceptional storms and hurricanes. Specific design factors are described in the following subparagraphs.

a. Design Tide. - The design tide is the maximum elevation which occurs about once a year. The elevation of design tide is 11.8 feet above mean low water. (Mean range plus 3.1 feet).

b. Design Wave. - The fetch across Massachusetts Bay is 54 nautical miles. Using wave forecasting curves, the various wave heights possible to attain with various wind speeds for a fixed fetch of 54 nautical miles are listed below:

Wind Speed	Duration	Wave Height	Period
80 MPH	4 Hrs.	25'	11 Sec.
70 MPH	4-1/3 Hrs.	22'	10.4 Sec.
60 MPH	4-1/2 Hrs.	17.2'	9.7 Sec.
50 MPH	5 Hrs.	14'	9.0 Sec.
40 MPH	5-1/2 Hrs.	10.4'	8 Sec.

A tabulation from Technical Memorandum No. 55, Wave Hindcast Data, prepared by the Beach Erosion Board, showing the duration of various wave heights originating from the south to the southeast, during the three-year period 1948-1950 is shown below:

Wave Height	Duration
25'-30'	4 Hrs.
20'-25'	4 Hrs.
18'-20'	4 Hrs.
16'-18'	12 Hrs.
14'-16'	36 Hrs.
12'-14'	68 Hrs.
10'-12'	172 Hrs.

The tabulations show that waves between 12 feet and 14 feet occurred for 68 hours during this period and that a 14-foot wave could be generated by 50 MPH winds across this limited fetch. It was therefore decided to use a deep water design wave of 14 feet. A refraction analysis for waves approaching from the southeast quadrant showed that the Stellwagen Bank, running from Provincetown in a northwest direction across Massachusetts Bay acts as a lens to focus the incoming waves around Eastern Point into Gloucester Harbor. A refraction coefficient of 0.74 was determined, which would reduce a 14-foot deep water wave to 10.4 feet in Gloucester Harbor. Checking the depth of water at the proposed site of the structure tip to determine if a wave of this height could be sustained without breaking, by using the solitary wave formaula $H = d/1.28$ it was determined that waves could reach 16.2 feet in height before breaking. The design wave of 10.4 feet was therefore indicated.

c. Stone Sizes. - The minimum size and the slopes of cover stones in a protective structure are computed using the United States Army Waterways Experiment Station formula -

$$W = \frac{W_r \ H^3}{K_\Delta \ (S_r - 1)^3 \ \text{Cot} \ \alpha}$$

Where

W = Weight of stone in pounds

W_r = Unit weight of stone in pounds/cu. ft.

K_Δ = A coefficient; 3.0 for the trunk of structures; 2.5 for the head of structures

S_r = Specific gravity W_r/W_w = $\frac{\text{Unit wt. stone}}{\text{Unit wt. water}}$

α = Angle of slope to the horizontal

H = Wave height at structure

Minimum weights of armor stones and slopes were determined as tabulated below:

Wave Height	Slope	K_Δ	Min. Weight
10.4'	1 on 2	2.5	5 Tons
10.4'	1 on 2	3.0	4 Tons
4.7'	1 on 1.5	3.0	1/2 Ton

The underlayer immediately beneath the armor stone was computed to have a minimum weight of 10 percent of the armor stone. The required size of the breakwater is too small to practically use more than one under layer for the deeper section and a graded core only for the shallower section. The quarry run core should be graded to have the coarser material on the outside next to the 1/2 ton stone, and equal to 10 percent of its weight or 100 pounds.

The top width and thickness of armor stone and under layer were computed in accordance with formulas developed by the U. S. Army Waterways Experiment Station. A crest width of 10 feet is furnished as also being the minimum acceptable for operation of construction and maintenance equipment.

d. Wave run-up. - The wave run-up was estimated for the proposed stone structure using methods described in Technical Report No. 4 of the Beach Erosion Board. A wave height of 10.5 feet was used based on the most common period of 9 seconds over a fetch distance of 54 nautical miles with a wind velocity of 50 miles per hour.

Utilizing the design tide still water elevation of 11.8' combined with the run-up, a top elevation of 26 feet above mean low water would be necessary to prevent all overtopping. However, it is considered that a certain amount of overtopping can be tolerated. A top elevation of 20 feet above mean low water is considered adequate. Overtopping of 6 feet is considered allowable as this would not have a significant effect in the harbor particularly with a ten foot crest width to further reduce wave energy. The occurrence of the design wave during design tide conditions would be infrequent. Also the likelihood of a set of circumstances occuring concurrently to develop this design wave under higher flood conditions is considered to be highly improbable.

PLANS OF PROTECTION

12. Description. - A topographic and hydrographic survey was made for the area as shown on Plate 3. Detailed sounding information in combination with the overall physical features as shown on Plate 1 were utilized in formulating the plans of protection.

Two plans of protection, Plan "A" and Plan "B" were considered to furnish wave protection to boats moored at the launchway and to control the sand accretion which has been occurring adjacent to the marine railway at the boathouse.

Plan "A" would be the maximum plan, offering a greater degree of latitude for usage based on long range requirements. Plan "B" is considered as the minimum acceptable plan based on present usage.

In order to simplify the report, only details of the maximum plan are presented. The minimum plan is similar in design, the only difference being the change in alinement which results in a shorter and consequently less costly structure. For details of the plans and sections see Plate 2.

Plan "A" consists of the construction of a rubble mound structure about 600 feet in length, (about 175 feet longer than Plan "B") and with a 10 foot top width 20 feet above mean low water. This structure, serving in the dual capacity of a groin and a breakwater, extends generally in a north northeast direction from the point of land at the east side of the U. S. Coast Guard property for a distance of 470 feet. It then runs in a north northwest direction for about 120 feet. The slopes and stone sizes vary and are tabulated below:

	Slopes		Stone Sizes		
	Seaward	Landward	Armor	Under Layer	Core
Tip	1 on 2	1 on 2	5 Ton	1/2 Ton	100# max
Outer 40'	1 on 2	Transition	4 Ton	1/2 Ton	100# max
Next 260'	1 on 2	1 on 1.5	4 Ton	1/2 Ton	100# max
Next 50'	Transition	1 on 1.5	Transition	Transition	100# max
Inner 240'	1 on 1.5	1 on 1.5	1/2 Ton	100 #	100# max

13. Estimated Cost of Construction and Maintenance. - The first cost of construction of the plans is estimated and tabulated below:

PLAN A

Item	Quantity	Unit	Unit Cost	Cost
Armor & Under-layer stone	20,400	Tons	7.50	$153,000
Core Stone	10,500	Tons	4.00	42,000
Contingencies				39,000
Engineering & Design				11,000
Supervision & Administration				20,000
				$265,000

PLAN B

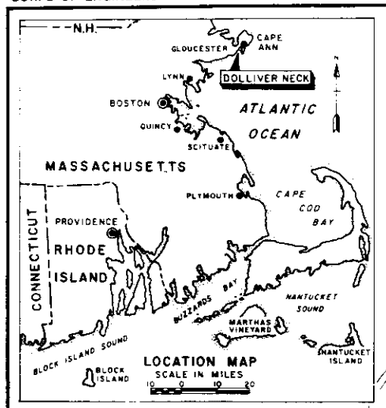
Item	Quantity	Unit	Unit Cost	Cost
Armor & Under-layer stone	12,800	Tons	7.50	$96,000
Core Stone	6,000	Tons	4.00	24,000
Contingencies				24,000
Engineering & Design				7,000
Supervision & Administration				14,000
				$165,000

The annual maintenance cost of the two plans is estimated as $2,700 for Plan "A" and $1,700 for Plan "B". The cost of real estate necessary to tie the structure into high ground is not included in the estimate. It is understood that the Coast Guard is contemplating buying this land under its expansion program.

14. Discussion and Conclusions. - The problem at the launchway site of the U. S. Coast Guard Lifeboat Station at Dolliver Neck, Gloucester Harbor, is that of accretion along the shore and wave action during storms. A suitable answer to this problem is the construction of a stone mound breakwater with a sand tight core to dissipate the waves during storms, and prevent the passage of littoral materials. Some overtopping of the structure can be tolerated as this would not have a significant effect in the harbor. It is understood that consideration may be given in the future to any necessary dredging for maneuvering or mooring areas or channels. This study does not deal with this problem.

CORPS OF ENGINEERS

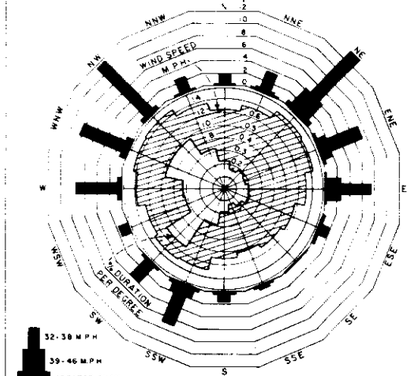
U. S. ARMY



*DURATION FOR EACH RANGE OF WIND SPEEDS IS MEASURED OUTWARD FROM TOP OF UNDERLYING BAR GRAPH

NOTE:

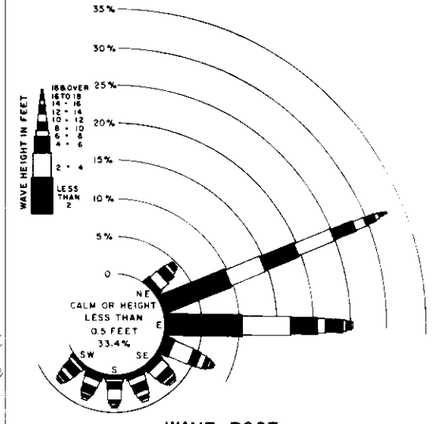
PERCENT DURATION PER DEGREE IS THE AVERAGE PERCENT DURATION OBSERVED FOR EACH 16 POINTS OF THE COMPASS DIVIDED BY 22 1/2 DEGREES



WIND ROSE

LOGAN AIRPORT, BOSTON, MASS.
OCTOBER 1949 – SEPTEMBER 1959
10 YEAR RECORD

COMPOSED OF DATA OBTAINED BY HINDCAST OF 3 YEARS OF WIND RECORDS (1948-1950) SHOWING PERCENT OF TIME WAVES OF DIFFERENT HEIGHT OCCUR FROM EACH DIRECTION. FROM BEACH EROSION BOARD, TECH. MEMO. NO. 55.



WAVE ROSE

OFF NAUSET BEACH, CAPE COD, MASS.
(LAT. 41° 50' N, LONG. 69° 30' W)

TRACED FROM ENLARGEMENT OF C.&G.S. CHART NO. 243

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS, WALTHAM, MASS.

DOLLIVER NECK
GLOUCESTER, MASS.
GENERAL PLAN

SHEET 1 OF 1 — SCALE IN FEET — DECEMBER 1964

500 0 500 1000 1500

APPROVED: Lt. Col. Wm. Ends
CHIEF ENGINEERS DIVISION

SUBMITTED: E. L. Hill
CHIEF, PLANNING AND REPORTS BRANCH

L. W. Sagarsky
CHIEF, RIVER AND HARBOR SECTION — DR. BY A.D.C.

Carl E. Gerlach
PROJECT ENGINEER — TR. BY A.D.C. — CH. BY

TRANSMITTED WITH REPORT DATED MARCH 5, 1965

FILE NO. 271-Dr. 37

PLATE NO. 1

CORPS OF ENGINEERS

U. S. ARMY

E 819,400 E 819,600 E 819,800 E 820,000 E 820,200 E 820,400

N 583,200 N 583,000 N 582,800 N 582,600 N 582,400

GLOUCESTER HARBOR

N

STONE PIER

PROPOSED 8-FOOT CHANNEL

100'

5+00

3+80

3+42.8

PLAN B
℄ ALINEMENT

PLAN A

10'

SLOPE

PROPOSED BREAKWATER

0+33

TOE

PROPOSED 8' SLIP

42'

Property Line

COAST GUARD BOAT HOUSE

Ramp

Road

Gravel

Property Line

0+90

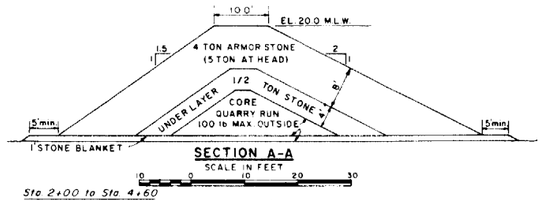
Piles

Swimming Pool

Wharf

DOLLIVER NECK

STONE PIER



SECTION A-A

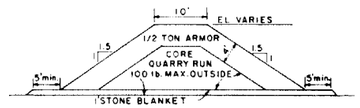
SCALE IN FEET

10 0 10 20 30

Sta 2+00 to Sta 4+60

Back slope - Transition to 2.0 on 1.0 Sta 4+50 to Sta 5+00

Exposed slope - Transition to 1.5 on 1.0 Sta 2+00 to Sta 1+50.



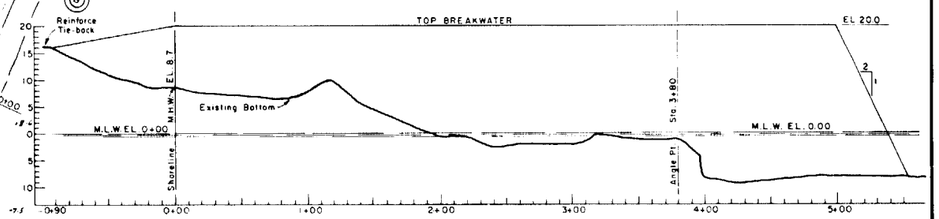
SECTION B-B

SCALE IN FEET

10 0 10 20 30

Sta. -0+90 to 1+50

Exposed slope - Transition to 2.0 on 1.0 Sta 1+50 to Sta. 2+00.



CENTERLINE PROFILE

SCALE IN FEET

HOR 40 0 40 80 120

10 0 10 20 30 VER

NOTES:

Elevations are in feet and tenths and are referred to the plane of Mean Low Water. Mean range of tide is 8.7 feet above the plane of Mean Low Water.

Topography from plane table survey of June 1964 by E. Byram and U.S. Coast Guard plan No. 5782

T.B.M. "RAIL" Elev. 14.13 above M.L.W.

Property lines of boat station shown thus: ——————

Coordinates are on the Lambert System for the State of Mass.

Mean High Water shown thus: ——————

E 820,400

N 582,400

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS, WALTHAM, MASS.

DOLLIVER NECK
GLOUCESTER, MASS.
PLAN & SECTIONS

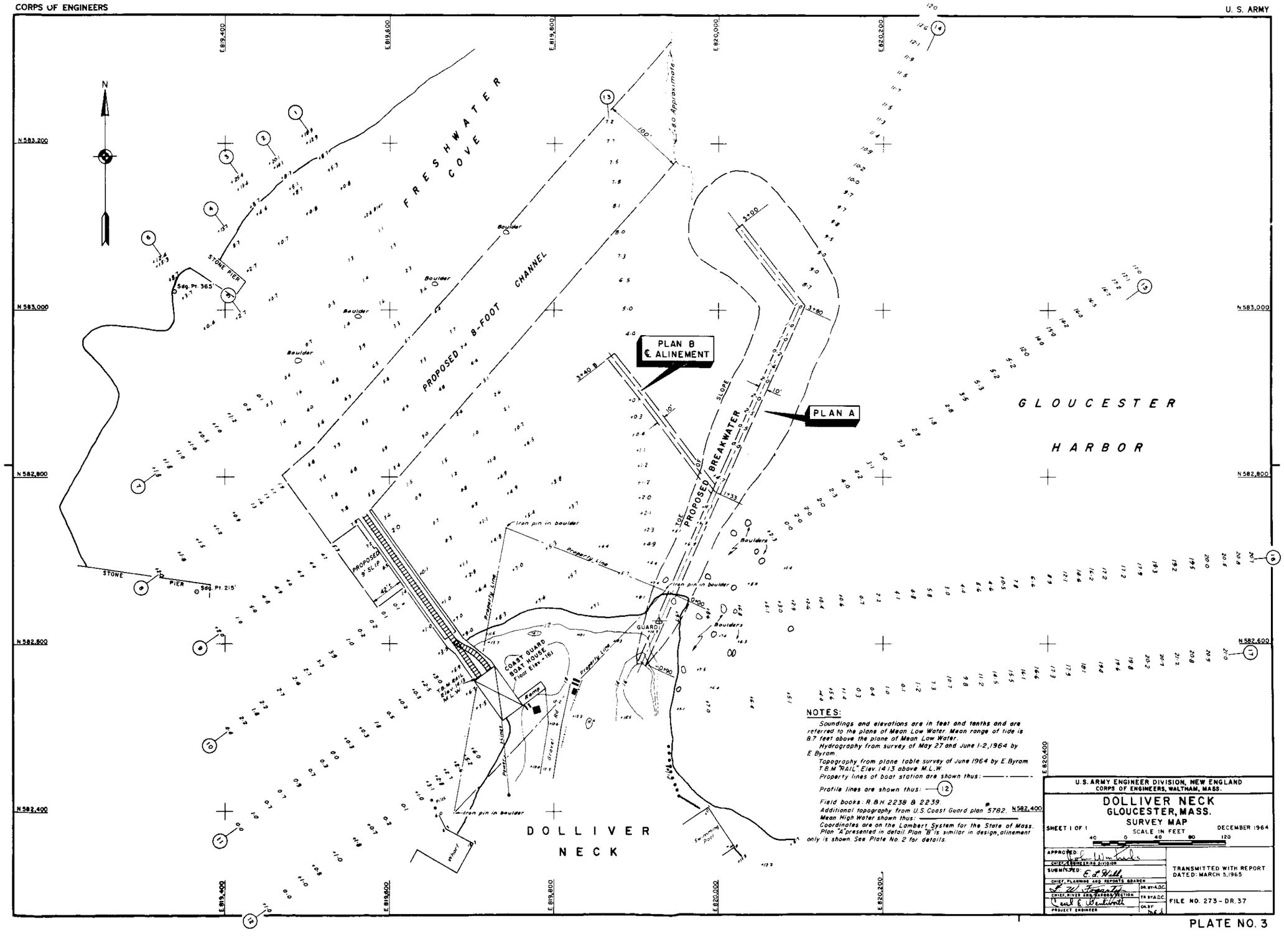
SHEET 1 OF 1 SCALE IN FEET 40 0 40 80 120 DECEMBER 1964

APPROVED: CHIEF, ENGINEERING DIVISION	
SUBMITTED: CHIEF, PLANNING AND REPORTS BRANCH	TRANSMITTED WITH REPORT DATED: MARCH 5, 1965
CHIEF, RIVER AND HARBOR SECTION	FOR BY A.D.C.
PROJECT ENGINEER	FOR BY A.D.C.
	CH BY

PLATE NO. 2

CORPS OF ENGINEERS

U. S. ARMY



NOTES:

Soundings and elevations are in feet and tenths and are referred to the plane of Mean Low Water. Mean range of tide is 8.7 feet above the plane of Mean Low Water.

Hydrography from survey of May 27 and June 1-2, 1964 by E. Byram.

Topography from plane table survey of June 1964 by E. Byram. T.B.M. "RAIL" Elev. 14.13 above M.L.W.

Property lines of boat station are shown thus: ——·——·——

Profile lines are shown thus: —(12)

Field books: R.B.H. 2238 & 2239.

Additional topography from U.S. Coast Guard plan 5782.

Mean High Water shown thus: ——

Coordinates are on the Lambert System for the State of Mass.

Plan "A" presented in detail. Plan "B" is similar in design, alinement only is shown. See Plate No. 2 for details.

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS, WALTHAM, MASS.

DOLLIVER NECK
GLOUCESTER, MASS.
SURVEY MAP

SHEET 1 OF 1 — SCALE IN FEET (40 0 40 80 120) — DECEMBER 1964

APPROVED: [signature]
CHIEF, ENGINEERING DIVISION

SUBMITTED: E. A. Hill
CHIEF, PLANNING AND REPORTS BRANCH

[signature]
CHIEF, RIVER AND HARBOR SECTION

[signature]
PROJECT ENGINEER

DR. BY H.D.C.
TR BY A.D.C.
CK BY

TRANSMITTED WITH REPORT DATED: MARCH 5, 1965

FILE NO. 273 - DR. 37

PLATE NO. 3

APPENDIX A

TREASURY DEPARTMENT U. S. COAST GUARD CG-10127 (Rev. 5-55)	REQUEST FOR WORK TO BE PERFORMED BY OTHER GOVERNMENT AGENCIES	REQUEST NO. ecv-331-64
		DATE OF REQUEST 20 March 1964

SECTION I - REQUEST DATA

TO: (Activity to Perform Work)	FROM (Ordering Office)
U. S. Army Engineering Division N.E.	Commander, First Coast Guard District Boston, Massachusetts
UNIT FOR WHICH WORK IS TO BE PERFORMED	OFFICE TO BE BILLED
Gloucester Lifeboat Station	CGCG District, Boston, Massachusetts

APPROPRIATION SYMBOL AND TITLE	SUBHEAD OR PROJECT NO.	CLASS AND UNIT CODE	OBJECT NO.
20X0201	01-43. G. 64	~~235~~ 30136	2530

DESCRIPTION OF WORK TO BE PERFORMED — ESTIMATED COST

1. Make an accretion study at the U. S. Coast Guard Lifeboat Station Boathouse and Launchway site located at Dolliver Neck, Gloucester Harbor, Gloucester, Mass.

2. The study is to include:

a. A hydrographic and topographic survey of the area.

b. A study of the erosion and accretion conditions particularly with respect to material deposited against the launchway.

c. A study of the wave conditions in the vicinity of the launchway.

d. Development of a detailed plan of protection with estimates of quantities and costs for reduction of accretion and provision of safe moorings of vessels in the vicinity of the launchway.

e. A report with drawing of the plan of protection.

3. Work to be initiated at an early date and completed within six (6) months thereafter.

4. Billing to be on a quarterly basis on Standard Form 1080.

5. For general information purposes, the following communications apply:

Ref. (a) CGCGD ltr to Div. Engr. U.S.Army Corp of Engrs., file e H1 dtd 24 December 1963

Ref. (b) U.S. Army Engr Div. ltr File No. NEDE D-R dtd 24 Feb. 1964

Purchase Order Number 4LG233H1988 applies.

$4,500.00

TYPED NAME AND TITLE	SIGNATURE
W. C. BROWN, CDR, USCG, Chief Civil Engr. Br.	

SECTION II - RECEIPT OF ORDER

(Acknowledge receipt and acceptance of this order by signing and returning the duplicate copy to the ordering office.)

Acceptance of this order, subject to the conditions stated, is hereby acknowledged.

DATE	TITLE	SIGNATURE
26 March 1964	Chief, Engrg.Div.	JOHN WM. LESLIE

PREVIOUS EDITIONS ARE OBSOLETE.

TREASURY DEPARTMENT
UNITED STATES COAST GUARD

ADDRESS REPLY TO:
COMMANDER
1st COAST GUARD DISTRICT
1400 CUSTOMHOUSE
BOSTON MASS. 02109

e
H1

24 DEC 1963

From: Commander, First Coast Guard District
To: Division Engineer, U. S. Army Corps of Engineers, New England Division, 424 Trapelo Road, Waltham 54, Massachusetts

Subj: Gloucester Lifeboat Station; accretion study

1. Reference is made to the U. S. Coast Guard Lifeboat Station boathouse and launchway site located at Dolliver Neck, Gloucester Harbor, Gloucester, Massachusetts. The coordinates of the site are 42°-35'-46" and 70°-41'-03" as shown on Coast and Geodetic Survey Chart Number 233.

2. In recent years, accretion immediately east of the inboard end of the referenced launchway has been accelerated, with material during easterly storms being deposited on the upper slope of the launchway. In this connection, inquiry is made as to whether you would undertake to:

a. Make a survey of the erosion and accretion conditions at this location.

b. Furnish recommendations as to the nature and extent of remedial measures required to protect against the further deposit of material against the launchway.

c. Make consistent recommendations as to the location and direction of a breakwater type structure that would provide safe mooring in the near vicinity of the launchway during rough weather.

3. It is requested that you furnish the approximate cost of such services, payment for which would be made on an exchange of funds basis.

P. J. SMENTON
Chief of Staff